

portion of the light received at the secondary mirror **102** to pass through as an output beam **140**.

**[0015]** The laser resonator system **100** also includes the primary mirror **104**. The primary mirror **104** is configured to reflect a beam along a forward optical path toward the secondary mirror **102**. For example, the primary mirror **104** may receive the beam projected along the return optical path and may reflect the beam along the forward optical path. Thus, the primary mirror **104** and secondary mirror **102** form two optical paths: the forward optical path in a forward direction toward the secondary mirror **102** and the return optical path in a return direction toward the primary mirror **104**.

**[0016]** Along the two optical paths are one or more fold mirrors, such as fold mirrors **108**. The fold mirrors **108** are configured to direct (e.g., reflect) light beams along the two optical paths in the appropriate directions. For example, a particular fold mirror of the fold mirrors **108** may receive a first beam along the return optical path from the secondary mirror **102** and may direct the first beam along the return optical path toward the primary mirror **104**. Additionally or alternatively, the particular fold mirror may receive a second beam along the forward optical path from the primary mirror **104** and may direct the second beam along the forward optical path toward the secondary mirror **102**. In the particular embodiment illustrated in FIG. 1, the laser resonator system **100** includes three fold mirrors **108**. In other embodiments, the laser resonating system **100** may include more than three fold mirrors **108** or fewer than three fold mirrors **108**.

**[0017]** The laser resonator system **100** also includes a gain medium. In a thin disk laser resonator system, such as the laser resonator system **100**, the gain medium may be a portion of one or more active mirrors **106**. Although three active mirrors **106** are illustrated in FIG. 1, the laser resonator system **100** may include more than three active mirrors **106** or fewer than three active mirrors **106**. In this example, the gain medium may be mounted (e.g., coupled) to a back surface of each of the active mirrors **106** (e.g., thin disks). In a particular embodiment, the gain medium may be ytterbium-doped yttrium aluminum garnet (Yb:YAG). The back surface of the active mirrors **106** may be a highly reflective surface such that light received along either of the two optical paths may be reflected in a direction along the respective optical path.

**[0018]** In order to initiate and control projection of beams along the optical paths, the active mirrors **106** may be provided with pump light from one or more pump light sources **110**. The pump light sources **110** may include laser diodes configured to provide pump light to the active mirrors **106** to excite the gain medium of the active mirrors **106**. When the excitation of the gain medium exceeds a lasing threshold, the active mirrors **106** “lase” (e.g., emit light amplified stimulated emission), thereby projecting light (e.g., beams). Thus, when pump light is provided from the pump light sources **110** to the active mirrors **106**, the active mirrors **106** may begin to project light along the forward optical path, along the return optical path, or both.

**[0019]** Each beam travels along the optical paths of the laser resonator system **100** by being reflected by at least one of the fold mirrors **108**, the active mirrors **106**, the secondary mirror **102**, and the primary mirror **104**. Travelling along the optical paths causes the beam to resonate and to gain energy. For example, as a particular beam travels through each gain

medium on the active mirrors **106**, the energy of the beam increases (e.g., additional photons are emitted by the gain medium). Accordingly, as more active mirrors **106** are added to the laser resonator system **100**, power generated by the laser resonator system **100** (e.g., power of the output beam **140**) may increase. Thus, thin disk laser resonators provide a convenient mechanism for generating a high power (e.g., high energy) laser output.

**[0020]** In a particular embodiment, each of the fold mirrors **108** is designed to transmit a very small portion of light through the fold mirror. For example, despite having a highly reflective coating, each of the fold mirrors **108** may transmit (e.g., leak) a portion of a forward beam and a portion of a return beam. In this example, the forward beam refers to light projected along the forward optical path (e.g., light which is generally directed from the primary mirror **104** toward the secondary mirror **102**) and the return beam refers to light travelling along the return optical path (e.g., light which is generally directed from the secondary mirror **102** toward the primary mirror **104**). As illustrated in FIG. 1, a particular fold mirror **108** may transmit a portion of the forward beam as forward beam transmission (e.g., leakage) and may transmit (e.g., pass through the particular fold mirror **108** rather than reflect) a portion of the return beam as return transmission (e.g., leakage). Power of the forward beam transmission and the return beam transmission may be based on a transmission characteristic **T** of the particular fold mirror **108**. In a particular embodiment, the transmission characteristic **T** may be selected during a design process to minimally effect power of the forward beam and the return beam while providing sufficient power of the forward beam transmission and the return beam transmissions. Although the forward beam transmission and the return beam transmission are illustrated in FIG. 1 as being sampled at the particular fold mirror **108** that is closest to the secondary mirror **102**, the forward beam transmission and the return beam transmission may be sampled at any one or more of the fold mirrors **108** of the laser resonator system **100** in other embodiments. For example, the forward beam transmission and the return beam transmission may be sampled at a second fold mirror when a gain (**G**) of each active mirror **106** (e.g., each individual disk) is substantially similar, as further described with reference to FIG. 2.

**[0021]** Because the beams are directional, the beam transmissions continue along their respective directions of travel when the beams strike approximately the same point on the particular fold mirror **108**. Thus, by placing a first sensor (e.g., a first power sensor) along a direction of travel of the forward beam transmission and placing a second sensor (e.g., a second power sensor) along a direction of travel of the return beam transmission, relative power of the forward beam transmission and relative power of the return beam transmission may be sampled.

**[0022]** The forward beam and the return beam may have different energy levels at any point in the laser resonator system **100**. For example, at the particular fold mirror **108** closest to the secondary mirror **102**, the forward beam may have more energy than the return beam because only a portion of the forward beam is reflected by the secondary mirror **102** as the return beam. By using the same fold mirror (e.g., the particular fold mirror **108**) to sample the relative power (or energy) of each beam transmission, variations among fold mirrors do not influence the relative power of the sampled beam transmissions. Similarly, since the beams